

To: Harris County Judge Lina Hidalgo
From: Katie Short, Director; Amber Weed, Chief of Staff and Director of Policy; Will Janowski, Analyst
CC: Alex Triantaphyllis, Wallis Nader, Aaron Dunn, Vanessa Toro with the Harris County Judge's Office
Date: December 14, 2021
Re: **Storm Surge Abatement Memo**

EXECUTIVE SUMMARY

The Commissioners Court's Analyst's Office (the "Analyst's Office") received a request from the County Judge's Office to work with the Office of the County Engineer, the County Attorney's Office, and other stakeholders, as necessary, to develop a report on the Galveston Bay Park Plan (GBPP), the Coastal Texas Study (referred to as "Ike Dike"), and any other proposed alternatives intended to protect Galveston Bay, adjoining counties, and critical assets from the increasing risks of storm surge and rising sea levels.

This memo includes a discussion of the changing threats of both tropical cyclones and the resulting storm surge to the Gulf Coast region, along with a summary of the current understanding of key projects to mitigate the threat of storm surge to the Gulf Coast region. A recent National Oceanic and Atmospheric Administration (NOAA) report predicts an increased number of Category 4 or 5 tropical cyclones in the Gulf Coast region in the coming century, with greater storm surge exacerbated by sea level rise. These factors will make future storm surge events more costly and hazardous for the region.

The **Coastal Texas Study** and the **Galveston Bay Park Plan** are both designed to mitigate the risk of coastal flooding caused by storm surge. These projects have been determined not to be in competition and may coexist to address storm surge if stakeholders decide to pursue both. The risk of flooding from a Hurricane Harvey type event would not be reduced by the Coastal Texas Study nor the Galveston Bay Park Plan. The USACE also notes that any storm surge mitigation system will not provide complete risk reduction to the Texas Coast from every storm.¹

The Coastal Texas Study is a "Multiple Lines of Defense" strategy which uses natural and man-made infrastructure to keep Gulf surges from coming into the Bay during a storm and to protect the west side of Galveston Bay and the backside of Galveston Island from in-Bay storm surge, as well as restore over 6,600 acres of coastal ecosystems and provide 2.9 miles of coastal storm risk reduction on South Padre Island.

- The Coastal Texas Study will take approximately 19 years to complete, **with an estimated completion date of 2043**, based on potential funding appropriations from Congress as early as 2023.ⁱ
- Using a USACE Category 2 hurricane model as an example of storm surge reduction, the current Coastal Texas Study models a potential **10-foot reduction in storm surge, which equates to a greater than 50% reduction in storm surge for Galveston Bay.**
- The **cost to build the Coastal Texas Study is estimated to be \$28.9 billion**, with financing shared between a federal sponsor at 65% and a non-federal sponsor at 35%. Maintenance and operation costs are estimated to be \$131 million per year and will be 100% financed by the non-federal sponsor.^{ii iii iv} A non-federal sponsor is responsible for just over \$10 billion in costs during the 19-year design/build phase.
- The Coastal Texas Study final feasibility study is currently planned to be completed and sent to Congress in 2022 **for authorization in the 2022 Water Resource Development Act (WRDA)**. Congress will then need to appropriate funds to finance the study following Congressional authorization.
- **The 87th Texas Legislature passed legislation necessary to establish the Gulf Coast Protection District (GCPD) to function as one of the non-federal sponsors** on the Coastal Texas Study for the Coastal Storm Risk Management features (gates, dunes, and the Galveston Ring.) Harris County is a member of the District.^v
- **Harris County has an opportunity to join regional partners in directing the project's future direction** through participation with the GCPD, (including seeking Congressional authorization in 2022 WRDA), and potential work with Congressional delegates to understand possible funding mechanisms in the current Infrastructure Investment and Jobs Act.

The Galveston Bay Park Plan (GBPP) is a dual-purpose barrier island system and park designed by Rice University's Severe Storm Prediction, Education, & Evacuation from Disasters Center (SSPEED Center) to complement the Coastal Texas Study and to afford initial surge protection for the Galveston Bay and protection for Galveston Island.

- **The design of the GBPP assumes that the Gulf Defense Projects from the Coastal Texas Study exist.**
- **The SSPEED Center designed the GBPP to protect West Galveston Bay and the Houston Ship Channel from a 25-foot storm surge event** generated from large Category 4 hurricanes. This description of risk mitigation does not assume the existence of the Coastal Texas Study projects, and additional studies are needed to confirm risk mitigation.
- The SSPEED Center currently proposes that the GBPP would in part be constructed using dredged material taken from the Houston Ship Channel,^{vi} but **further feasibility studies are needed**. Cost, finance, and timeline will be determined during future feasibility studies.
- The next step for the Galveston Bay Park Plan is to solicit funding from local partners to complete a feasibility study for the project.

ⁱ The Harris County Engineering Department states that Congress rarely appropriates enough funds to meet construction schedules.

ⁱⁱ The USACE certified cost estimates put the final "fully-funded" cost of the project with inflation accounted for to be \$47.6 billion.

ⁱⁱⁱ The ~\$2 billion dollar increase from the 2020 draft feasibility study is attributed to initial modeling result contingencies and updated quantities in the cost estimate.

^{iv} The \$28.9 billion estimate is the "first project cost," estimate. This estimate is the cost of the project if the USACE were to receive funding and build the final plan in 2021.

^v In addition, local entities such as counties, cities, levee improvement districts, drainage districts, municipal utility districts, or other special taxing entities may elect to or be created to support the GLO, GCPD, and the USACE in the implementation of this project.

^{vi} Dredging is the act of removing silt and other material from the bottom of bodies of water.

INTRODUCTION

During the September 15, 2020 meeting of the Harris County Commissioners Court, the County Judge requested the Commissioners Court's Analyst's Office (the "Analyst's Office") report on storm surge prevention projects "intended to protect Galveston Bay, adjoining counties, and critical assets from the increasing risks of storm and rising sea levels."

According to the request, for each proposed project, the Analyst's Office should identify the government stakeholders required for development, financing, and implementation; provide an overview and timeline of what has been accomplished on each potential project to date; discuss Harris County's authority and influence over each potential project; and lay out a proposed process and next steps for how Harris County should approach the development of a potential solution.

There are two key projects currently under consideration by regional leaders as potential solutions for mitigating storm surge in Galveston Bay: The Coastal Texas Protection and Restoration Feasibility Study's Galveston Bay Storm Surge Barrier System (the "Coastal Texas Study") designed by the US Army Corps of Engineers (USACE) and the Texas General Land Office (GLO), and the Galveston Bay Park Plan (the "Galveston Bay Park Plan") designed by the Rice University Severe Storm Prediction, Education, & Evacuation from Disaster (SSPEED) Center. According to the USACE, these two projects have been determined not to be in competition with each other, and may coexist to address storm surge if stakeholders decide to pursue both.

This memo includes a background discussion of the changing threats of both tropical cyclones and the resulting storm surge to the Gulf Coast region, along with a summary analysis of the current understanding of key projects to mitigate the threat of storm surge to the Gulf Coast region, and discussion of possible next steps for Harris County as a partner in this regional effort to mitigate storm surge. The Analyst's Office draws upon current literature as well as interviews with local business and environmental leaders, and federal, state, county, and city officials and administrators.

The Analyst's Office acknowledges representatives of the Harris County Flood Control District, the Harris County Engineering Department, the United States Army Corps of Engineers, the Texas General Land Office, the Rice University Severe Storm Prediction, Education, & Evacuation from Disasters Center (SSPEED Center), and the Gulf Coast Protection District for their significant contributions to this memo.

BACKGROUND

Current estimates show an increase in tropical cyclone activity is expected for the coming 100 years. Specifically, hurricane return rates for Harris and Galveston Counties predict a Category 1 or 2 hurricane strike every nine years, and a Category 3, 4, or 5 hurricane every 25 years.² Anticipated sea level rise coupled with the potential storm surge created by increasing tropical cyclone activity poses a threat to businesses and residents in the Gulf Coast region.

Tropical Cyclones. A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and has a closed low-level circulation.³ Tropical cyclones are typically categorized based on their wind speeds using the Saffir-Simpson Hurricane Wind Scale to differentiate the hurricane intensity, and are classified as follows:^{vii}

- Tropical Depression: A tropical cyclone with maximum sustained winds of 38 miles per hour (mph) or less.
- Tropical Storm: A tropical cyclone with maximum sustained winds of 39 to 73 mph.
- Hurricane: A tropical cyclone with maximum sustained winds of 74 mph or higher up to 110 mph, corresponding to a Category 1 or 2 hurricane.
- Major Hurricane: A tropical cyclone with maximum sustained winds of 111 mph or higher, corresponding to a Category 3, 4, or 5 hurricane.⁴

Between 1980 and 2020, there were over 285 weather disasters in the US, with tropical cyclones responsible for a total of \$997.3 billion in damages, with an average cost of \$19.2 billion per event.⁵ In 2020 alone, there were seven tropical cyclone-related landfalls in the US—six hurricanes and one tropical storm—each resulting in over \$1 billion in damages.⁶

According to the National Oceanic and Atmospheric Administration’s (NOAA) Historical Hurricane Tracks, Galveston County has experienced 29 tropical cyclone landfalls between 1863-2020.^{7 viii ix} **Table 1** shows the breakdown of these 29 tropical cyclones: 17 (59%) were tropical depressions or tropical storms, nine (31%) were hurricanes, and three (10%) were major hurricanes.

Table 1 Total Number of Tropical Cyclone Landfalls in Galveston County, 1863-2020						
Tropical Depressions or Tropical Storms (17 total)		Hurricanes (9 total)		Major Hurricanes (3 total)		
Tropical Depressions	Tropical Storms	Hurricanes Category 1	Hurricanes Category 2	Hurricanes Category 3	Hurricanes Category 4	Hurricanes Category 5
3	14	6	3	1	2	0

Source: United States National Oceanic and Atmospheric Administration- Historical Hurricane Tracks

The National Hurricane Center defines hurricane return periods as the frequency at which a certain intensity of a hurricane is expected within a given distance of a given location.⁸ Both Harris and Galveston counties should expect to see a Category 1 or 2 hurricane strike every nine years, and a Category 3, 4, or 5 hurricane every 25 years.⁹ This return period means that on average, during the next 100 years, a Category 1 or 2

^{vii} This scale does not consider other potentially deadly hazards such as storm surge, rainfall flooding, and tornadoes.

^{viii} NOAA’s Historical Hurricane Tracks system shows that 23 major hurricanes have made landfall in Texas since the United States started recording tropical cyclone landfalls in 1851: 18 Category 3 hurricanes; nine Category 4 hurricanes; and, one Category 5 hurricane.

^{ix} A hurricane is considered a landfall in Galveston County if the hurricane’s path crosses Galveston County.

hurricane will pass within 58 miles of Harris and Galveston counties about 11 times, and a Category 3, 4, or 5 hurricane, four times.

Storm Surge. Storm surge refers to the abnormal rise in water generated by a tropical cyclone and is caused by strong winds and low pressure from a storm.¹⁰ The rise in sea level can cause extreme flooding in coastal areas, especially when storm surge coincides with high tide.¹¹

There are two types of storm surge events relevant to Galveston Bay: coastal storm surge and in-bay storm surge. Coastal storm surge occurs when coastal waters from the Gulf of Mexico hit Galveston Island and the Bolivar Peninsula. In-bay storm surge occurs when hurricane-force winds force water from Galveston Bay toward the shorelines in Galveston Bay.^x

Storm surge events have the potential to cause property damage, loss of life, and potential spillage of hazardous materials in Galveston Bay. Storm surge events in Galveston Bay also pose a threat to the Houston Ship Channel, Texas City refining complexes, and the Bayport Industrial District, all key suppliers of refined oil and plastics for the nation.¹² During storm surge events, storage tanks that contain hazardous materials along the Houston Ship Channel could experience failure from water dislodging or crushing tanks, or from the penetration of debris carried with the storm surge.^{13 xi} There are approximately 12,900 storage tanks used by industrial facilities to store fuels and chemicals located within Galveston Bay.¹⁴

Sea Level Rise. Sea level is the average height of the ocean between high and low tides.¹⁵ Relative sea level trends measure the height of water along the coast relative to a specific point on land.^{16 xii} A higher local sea level means a high tide can push storm surge farther inland.¹⁷ As sea levels rise, there is increased risk of extensive coastal erosion.¹⁸ Rising sea levels also create stress on coastal ecosystems, which provide protection from storms and habitat for fish and wildlife.¹⁹

In Galveston, sea level rise is measured using tide gauges at the Galveston Pleasure Pier in the Gulf of Mexico and at Pier 21 in Galveston Bay. Sea level for the Galveston Coast, as measured from Pleasure Pier between 1957-2011, increased by 6.62 millimeters annually, which totals 2.17 feet over 100 years.^{20 xiii} For Galveston Bay, tide gauges at Galveston Pier 21 showed an increase of an average of 6.59 millimeters annually between 1904 and 2020, with the annual increase in sea level in Galveston Bay totaling to 2.16 feet over 100 years.²¹ A study by the Environmental Protection Agency (EPA) of the Texas coastal environment estimates that a one-foot rise in sea level along the Gulf Coast is likely by 2050, and in the next century, sea level along the Gulf Coast could rise an additional two-to-four feet.²²

^x Lake Okeechobee in Florida is an example of a Category 4 Hurricane-force wind producing a 10-foot inland storm surge event, which was only produced by water from within the lake.

^{xi} Since 1850, 16 hurricanes with storm surge greater than 16 feet, have struck Galveston Bay.

^{xii} Since 1880, the global mean sea level has risen about eight to nine inches, with a third of that increase occurring in the last 25 years. In 2014, the global sea level was 2.6 inches above the 1993 average and continues to rise at a rate of about one-eighth of an inch per year.

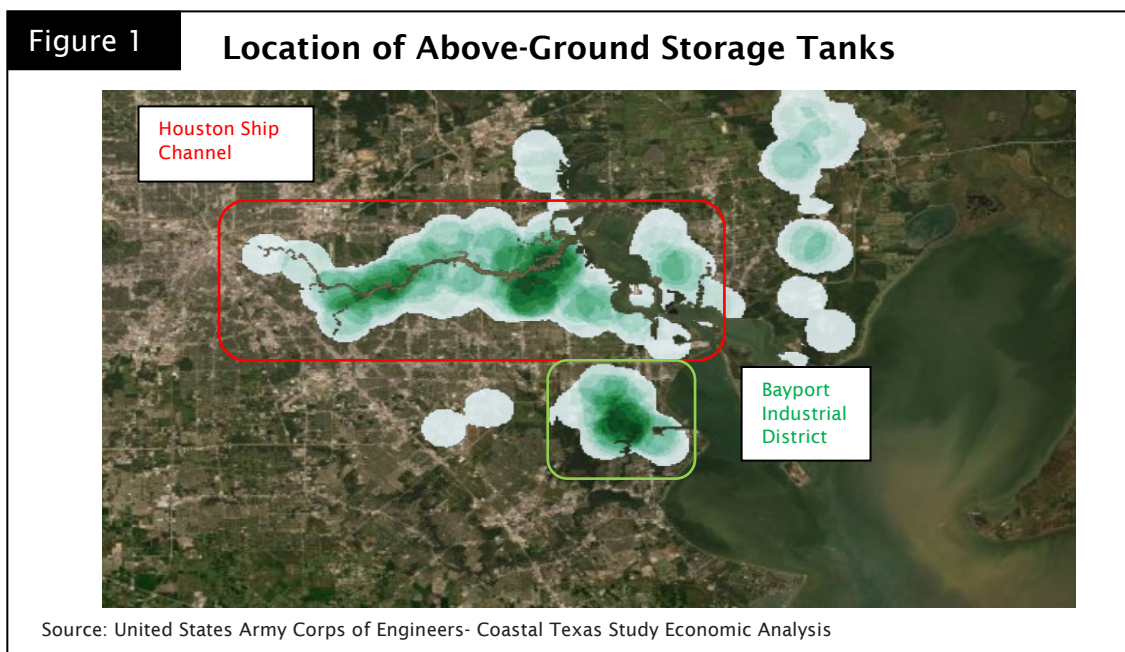
^{xiii} The Center for Operational Oceanographic Products and Services has been measuring sea level for over 150 years, with tide stations of the [National Water Level Observation Network](#) operating on all US coasts. Changes in sea level, have been computed at 142 long-term water level stations using a minimum span of 30 years of observations at each location.

The increase in number of tropical cyclones and tropical cyclone intensity, coupled with an increase in sea level rise, will make future storm surge events more costly and hazardous for the region.

Critical Assets in Galveston Bay. Galveston Bay hosts critical environmental and industrial sector assets for the Gulf Coast region. According to the Bay Area Houston Economic Partnership, the Gulf Coast region is responsible for 6% of the nation's gross national product.²³ While storm characteristics, like intensity and direction, determine the threat of each storm to assets in and around Galveston Bay, the risk of increased number storms, increased storm intensity, and increased storm surge height pose a considerable and cumulative threat to the environmental and industrial assets in Galveston Bay. Mitigating storm surge in the Texas Gulf would aid with protecting assets that contribute to the nation's and region's economic security.

Galveston Bay is the second-largest estuary in the United States.^{xiv 24} This ecosystem produces large harvests of recreational and commercial fish and shellfish for the US.²⁵ The Galveston Bay's oyster fishery industry contributes about \$9 million annually to the Texas economy.²⁶

The Port of Houston is also the number one US port in terms of waterborne tonnage, sustains 3.2 million jobs, has a national economic value of \$802 billion, and generates \$38 billion in tax revenue annually.²⁷ There are over 500 chemical plants in the region that produce a significant percentage of national production of a range of chemicals, including: 27% of gasoline; 60% of aviation fuel; 80% of military-grade fuel; 35% of natural gas production; and 42% of specialty chemical feedstock.²⁸ **Figure 1** shows that the majority of the 12,900 above-ground tanks around Galveston Bay are located in the Houston Ship Channel and the Bayport Industrial District.



^{xiv} Estuaries and their surrounding wetlands are bodies of water usually found where rivers meet the sea.

ASSESSMENT: PROPOSED STORM SURGE MITIGATION PROJECTS

Countries across the world are exploring innovations to protect their cities and industrial centers from the effects of climate change. The strategies explored by other countries to address the threat of storm surge are not unlike the strategies employed by the United States and not unlike those under active consideration for the Gulf Coast.

The Netherlands relies on a network of dams, dykes, and storm barriers called the Delta Works to control surges. This network includes the Hartel Barrier, a moveable computer-controlled barrier consisting of gates suspended between four towers near Spijkenisse.²⁹ The gates can hold back water levels of approximately ten feet above sea level.³⁰ In Shanghai, China constructed levees and seawalls to protect against sea level rise with a mechanical gate to regulate overflowing rivers.³¹ China also is actively constructing and remediating coastal wetlands and living breakwaters, such as mangroves, marshes, oyster reefs, and artificial reefs to buffer the coastal tides.³² In Melbourne, Australia, the country-built floodgates, tidal barrage, levies, pumps, stormwater drains, and flood basins to address coastal flooding and mitigate storm surge.³³

There are two key projects, each currently under consideration by regional leaders as potential solutions for mitigating storm surge in Galveston Bay: The Coastal Texas Protection and Restoration Feasibility Study's Galveston Bay Storm Surge Barrier System (the "Coastal Texas Study") designed by the US Army Corps of Engineers (USACE) and the Texas General Land Office (GLO), and the Galveston Bay Park Plan (the "Galveston Bay Park Plan") designed by the Rice University Severe Storm Prediction, Education, & Evacuation from Disaster Center (SSPEED Center). Each of the projects under local consideration include some element of one or more of the international projects reviewed. These two local projects have been determined not to be in competition with each other, and may be able to coexist to address storm surge, if stakeholders decide to pursue both. The Analyst's Office did not explore developing a new proposal for storm surge mitigation.

The assessment of each project includes: a description of the project; project alternatives considered (if applicable); development phases (including cost estimates, financing, government stakeholders as currently understood, and Harris County's potential involvement in the implementation of projects). The memo concludes with a discussion of storm surge risk mitigation for both projects and next steps.^{xv}

Table 2 provides a summary of key elements of the Coastal Texas Study and the Galveston Bay Park Plan. The Coastal Texas Study and the GBPP are not the same in terms of size and scope, with the Coastal Texas Study being much larger and more comprehensive while the GBPP is more targeted to the ship channel and surrounding Bay area.³⁴

^{xv} The government stakeholder list is not an exhaustive list of all stakeholders involved. Industrial, environmental, and other interest groups will likely be needed to work in concert with the Gulf Coast Protection District or local officials with the Galveston Bay Park Plan.

Table 2	Storm Surge Project Preliminary Summary	
	Coastal Texas Study	Galveston Bay Park Plan (GBPP)
Storm Surge Mitigation	This project is a “Multiple Lines of Defense” strategy using natural and man-made infrastructure to keep Gulf water out of the Bay and to protect the west side of Galveston Bay from in-bay storm surge.	This project is a dual-purpose barrier park constructed out of local dredged material that creates an island barrier system designed to stop in-bay storm surge from hitting West Galveston Bay and can be compared to the Coastal Texas Study’s “in-bay defense” system.
Timeline	Study Phase: October 2021 Design Phase: 2-5 years Build Phase: Estimated completion in 2043 Maintain Phase: 50 years after completion	Study Phase: Timeline TBD Design Phase: Timeline TBD Build Phase: Timeline TBD Maintain Phase: Timeline TBD
Sponsors	Federal sponsor: US Army Corps Non-federal sponsor - Study Phase: Texas General Land Office (GLO) Non-federal sponsor – Design/Build/Maintain Phase: Gulf Coast Protection District and GLO	Sponsors are not required for this project as federal funding will reportedly not be sought.
Government Stakeholders	<ul style="list-style-type: none"> – US Army Corps of Engineers – Texas General Land Office – US Senate and Congress members – Texas State legislators – Local representatives of jurisdictions near and around the Gulf Coast, including Chambers, Galveston, Harris, Jefferson, and Orange counties 	<ul style="list-style-type: none"> – US Army Corps of Engineers – Texas General Land Office – US Senate and Congress members – Texas State legislators – Local representatives of jurisdictions near and around the Gulf Coast, including Chambers, Galveston, Harris, Jefferson, and Orange counties
Projected Costs by Project Phase	Study Cost: \$20.6 million, actual Design and Build Costs: \$28.9B, estimated Maintain Cost: \$131 million annually, estimated	Study Cost: \$1 million, estimated Design and Build Costs: \$3B – \$5B, estimated Maintain Cost: TBD
Financing	<p>The federal sponsor, USACE, will cover 50% of costs for the Study phase and 65% of costs for the Design and Build phases.</p> <p>The non-federal sponsors are responsible for 50% of costs of the Study Phase, 35% for the Design and Build phases, and 100% of the cost to operate and maintain projects.</p>	Current proponents of the Galveston Bay Park Plan have stated their intent to seek only local funding for this project—no federal funding will be sought.
Implementation & Next Steps	<ul style="list-style-type: none"> – Seek Congressional authorization of Coastal Texas Study under WRDA (Estimated 2022) – Receive Congressional appropriation of funds (Estimated 2023) 	Receive funding for feasibility study (all other phases and required milestones for this project will follow the feasibility study)

THE COASTAL TEXAS STUDY

The Coastal Texas Protection and Restoration Feasibility Study (the “Coastal Texas Study”) is a joint study from the US Army Corps of Engineers (USACE) and the Texas General Land Office (GLO) that analyzes engineering, economic, and environmental measures related to storm surge mitigation for Texas coastal communities and industry, and ecosystem restoration for the region. The USACE describes the goal of the Coastal Texas Study as a plan “to enhance resiliency in coastal communities and improve capabilities to prepare for, withstand, recover and adapt to coastal hazards.”³⁵

Cost-sharing requirements for the Coastal Texas Study is set by federal law.³⁶ USACE projects require a federal sponsor (the USACE) and a non-federal sponsor (state or local partners) to fund USACE projects.^{37 xvi xvii} The federal and non-federal sponsors share the financing of the study, design, and construction of the project; however, the non-federal sponsor must also finance and maintain the project after construction.^{38 xviii} The non-federal sponsor is also required to have the ability to tax, eminent domain powers, and the authority to sign a project partnership agreement (PPA).^{39 40 41} The PPA is a legally binding agreement between the government and a non-federal sponsor for the construction of a water resources projects and describes the final responsibilities for cost-sharing.^{42 xix}

The 87th Texas Legislature passed Senate Bill (SB) 1160, which took effect on June 16th, 2021 and creates an entity, the Gulf Coast Protection District (GCPD), with the authority to finance and manage Coastal Texas Study projects. Currently, no other entity in Texas holds this authority.⁴³ The GCPD will meet the USACE requirements to serve as a non-federal sponsor of the Coastal Texas Study and any other water project in the GCPD.⁴⁴ Senate Bill 1160 provides the GCPD the authority to issue bonds, impose fees, or impose an ad valorem tax within the district. All proposed taxes and bonds to fund projects require the district to hold an election to obtain voter approval.⁴⁵ The GLO serves as the cost-share sponsor for part of the ecosystem restoration features for Galveston Bay and the South Padre coastal storm risk management features in the plan.⁴⁶

Table 3 provides the cost-sharing breakdown for federal and non-federal sponsors as well as financing entities for the Coastal Texas Study. The GCPD will be the non-federal sponsor of the Galveston Bay Storm Surge Barrier System and is responsible for paying approximately 35% of the project cost and 50% of the beach nourishment cost. The GLO was responsible for financing 50% of the study cost and will be responsible for 35% of the build costs for the South Padre Island project, 35% for Ecosystem Restorations projects, and 50% of the beach nourishment taking place on South Padre Island. The USACE will be the federal sponsor for the Coastal Texas Study and will fund the remaining totals for all projects.

^{xxi} The Texas General Land Office (GLO) is the non-federal sponsor for the study portion of the Coastal Texas Study; however, GLO does not have the powers needed to fund or manage the construction and maintenance portion of the project.

^{xxii} Projects that receive funds for federal implementation would be subject to the cost-sharing, financing, and other applicable requirements of federal law and policy, including WRDA 1986, as amended.

^{xxiii} Louisiana bypassed the traditional cost-sharing structure for the \$15 billion Hurricane Storm Damage Risk Reduction System, likely because funding was sought in the immediate aftermath of Hurricane Katrina. Congress provided a direct appropriation for the barriers that now mitigate the impact of storm surge on New Orleans. This direct appropriation of \$15 billion dollars was still under the 65%/35% cost-sharing agreement with the USACE.

^{xxs} As of September 21, 2021, the GCPD has not yet signed a PPA with USACE.

The Galveston Bay Storm Surge Barrier System operations and maintenance costs are currently entirely the responsibility of the GCPD. Maintenance cost for the South Padre Island Beach Nourishment and Sediment Management is expected to be minimal as well as maintenance costs for Ecosystem Restorations.

Table 3 Coastal Texas Study Cost-Sharing Arrangement			
	Total Cost per Phase	Federal Sponsor	Non-federal Sponsor/Financial Partners
Study Phase ⁴⁷	\$20.6 million	\$12.7 million (Actual cost)	\$7.9 million (Actual cost)
Build Phase	Galveston Bay Storm Surge Barrier System \$26.1 billion	\$15.6 billion USACE (65%)	\$9.4 billion (GCPD 35%)
		\$544.1 million (USACE 50%)	\$544.1 million (GCPD 50%)
	South Padre Island Beach Nourishment \$72.3 million	\$22.3 million USACE (65%)	\$7.5 million (GLO 35%)
		\$21.3 million (USACE 50%)	\$21.3 million (GLO 50%)
	Ecosystem Restoration \$2.7 billion ⁴⁸	\$1.8 billion USACE (65%)	\$863 million (GLO 35%)
Maintain Phase	Galveston Bay Storm Surge Barrier System \$131 million annually	\$0 (0%)	\$131 million annually (GCPD 100 %)
	South Padre Island Beach Nourishment	N/A	N/A
	Ecosystem Restoration	N/A	N/A

The GCPD includes five counties in the region: Chambers, Galveston, Harris, Jefferson, and Orange counties.⁴⁹ Brazoria County withdrew from the District.⁵⁰ The District is governed by an 11-member board of directors. As of August 18, 2021, the GCPD Board is fully appointed.⁵¹ Board composition includes: one director appointed by county commissioners courts from each of the five-member counties, and two additional directors appointed by the Governor to represent Harris County. Harris County technically has a total of three directors representing the County on the Board.^{xx} The remaining four members were appointed by the Governor to represent: (1) a municipality in the district, (2) ports, (3) industry, and (4) environmental interests.^{xxi 52}

^{xx} The three Harris County representatives include two appointed by Governor Abbot (Mayor Michel Bechtel of Morgans Point and Bob Mitchell of BAHEP) and one member selected by Harris County Commissioner's Court (Commissioner Adrian Garcia, Harris County Precinct Two).

^{xxi} The four remaining members appointed by Governor Abbott include: Sally Bakko (local municipality), Roger Guenther (ports), Michael VanDerSnick (Industry) Lori Traweek (environmental interests).

The Coastal Texas Study includes a combination of features called the Galveston Bay Storm Surge Barrier System, which is a “Multiple Lines of Defense” strategy to reduce coastal storm damages with natural and man-made infrastructure along the Texas Coast.

For the Upper Texas Coast portion of the Coastal Texas Study, which includes Galveston Bay, this “Multiple Lines of Defense” strategy incorporates two defenses: first, the Gulf Defenses, which stop Gulf waters from entering the Bay, and second, the Bay Defenses, which prevent any additional Gulf surge and in-bay storm surge from inundating inland areas of West Galveston Bay.⁵³ Included in the Coastal Texas Study are ecosystem restoration projects that address habitat loss and degradation from tides, waves, and sea level rise, and provide a natural buffer for coastal storm surge.⁵⁴ The USACE acknowledges that the Coastal Texas Study does not provide complete protection from storm surge for Galveston Bay, but offers risk reduction from storm surge events.⁵⁵

Gulf Defense Projects. The projects that comprise the Gulf Defense include: the Bolivar Roads Gate System, flanking beach and dune restoration, and Galveston Island Seawall improvements.

- **Bolivar Roads Gate System** is a system (2.8-mile structure), comprised of two large and two small navigation floating sector gates, 15 vertical lift gates, and 16 shallow water environmental gates that tie into the shoreline through combination walls and levees.⁵⁶ When closed during tropical cyclones, the Bolivar Gate system will be designed to reduce Gulf surge by 30-60%.⁵⁷
- **Beach and Dune Restoration** is 43 miles of beach and dune segments to be restored on Bolivar Peninsula and West Galveston Island. The beaches and dunes will work with the Bolivar Roads Gate System to form a continuous line of defense against Gulf of Mexico surge, preventing or reducing storm surge volumes that would enter the Bay system.⁵⁸
- **Galveston Island Seawall** includes improvements to the existing 10-mile Seawall on Galveston Island to complete the continuous line of defense against Gulf surge.⁵⁹

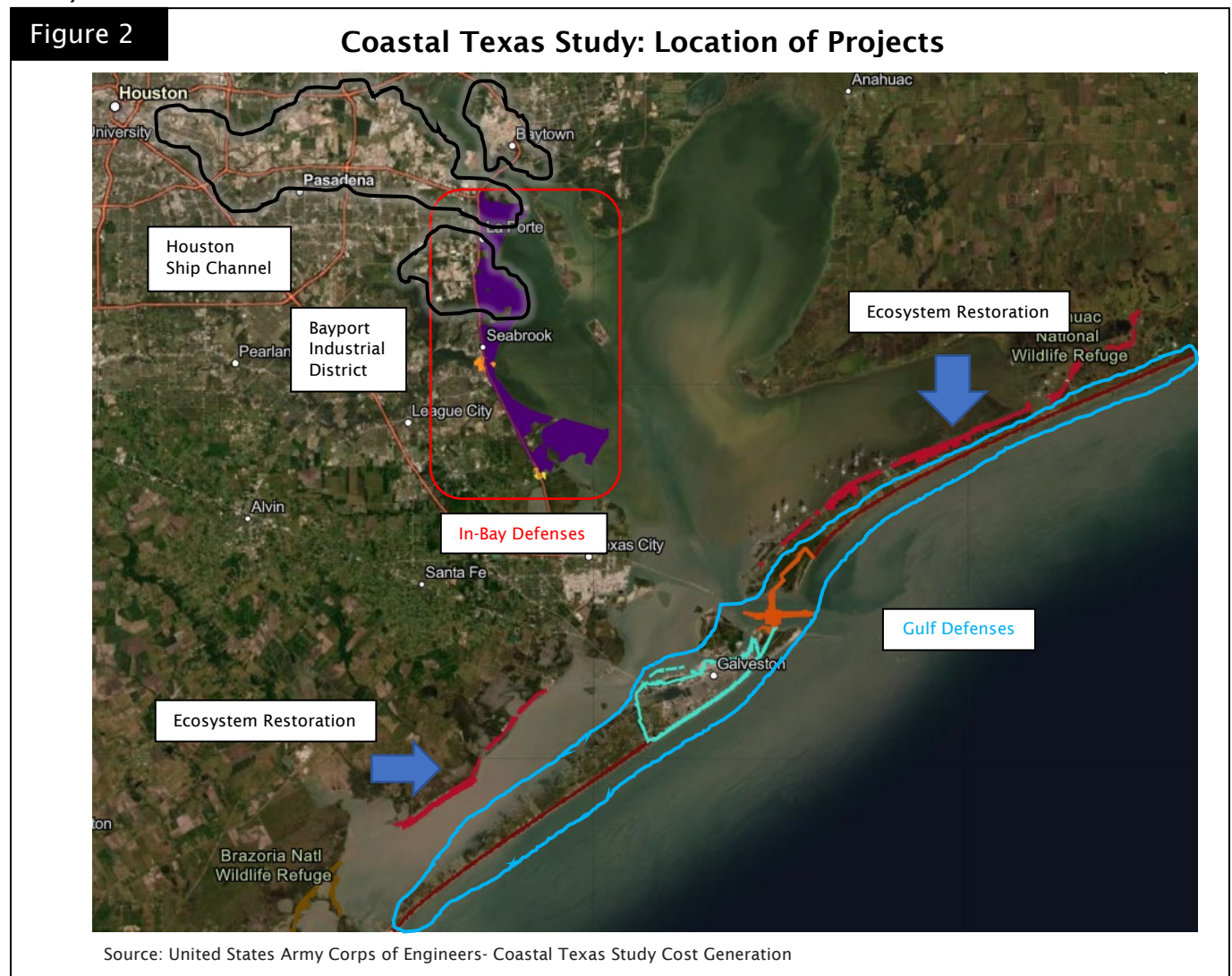
In-Bay Defense Projects. The projects that comprise the in-bay barrier include: the Galveston Ring Barrier System, Clear Lake Gate, Dickinson Gate system, and nonstructural measures.

- **The Galveston Ring Barrier System** is an 18-mile floodwall system that impedes Bay waters from flooding neighborhoods, businesses, and critical health facilities within the City of Galveston.⁶⁰
- **Clear Lake Gate** is a 75-foot-wide sector gate at the inlet of Clear Lake with gates for water circulation, a 17-foot-high floodwall, and a pumping station to pump water into Galveston Bay when the gate is closed.⁶¹
- **Dickinson Bay Gate** is a 100-foot-wide sector gate, an 18-foot-high floodwall, and pumping stations to pump water into Galveston Bay.⁶²
- **Nonstructural measures**, such as home elevations and floodproofing, further reduce Bay-surge risks along the western perimeter of Galveston Bay.⁶³

Ecosystem Restoration. Ecosystem restoration restores degraded ecosystems that buffer communities and industries on the Texas coast from erosion, subsidence, and storm losses. The USACE study team defines a living shoreline as a protected, stabilized coastal edge made of natural materials such as plants, sand, rock, and oyster reefs.⁶⁴ The plan includes restoration of oyster habitats, marshes, bird islands, hydrologic connectivity, and eroding shorelines in 6,610 acres of the Texas Coast near and around across Galveston, Brazoria, Matagorda, Calhoun, San Patricio, and Willacy Counties.⁶⁵ For Galveston Bay this includes 41 miles of ecosystem restoration near and around Galveston County, including the Bolivar Peninsula and, West Bay Intercoastal Waterway Shoreline.⁶⁶

The USACE considers the Ecosystem Restoration projects as highly effective nature-based solutions that have been proven to contribute to the overall resilience of the coastlines around the world. The Texas Coast's ability to prepare for, withstand, and adapt to climate change and coastal storms will be reportedly significantly enhanced by these protections.⁶⁷

Figure 2 displays the location of projects described in the Coastal Texas Study in and around the Houston and Galveston area: Gulf Defenses, In-Bay Defenses, and Ecosystem Restoration.



Notable environmental impacts.^{xxii} The USACE provides a summary of environmental impacts for notable projects described in the Coastal Texas Study.

- Bolivar Roads Gate’s physical structure, when open, will reduce the amount of water entering and exiting Galveston Bay by 7-10% due to the obstruction in the Ship Channel.⁶⁸ The changed flow is expected to impact salinity, sediment movement, and sediment accumulation across the Bay.⁶⁹
- Clear Lake and Dickinson Bay Gates are predicted to reduce water flow by 14-16%.⁷⁰ Impact to salinity was not modeled for these gates—further modeling will be conducted during the construction phase of the project.⁷¹
- Galveston Ring Barrier System will cross wetlands and other aquatic resources in the areas of Galveston Island protected by the seawall. While designed to reduce habitat impacts, there will be permanent impacts to wetlands.⁷²

COASTAL TEXAS STUDY ALTERNATIVES. Several variations of risk reduction plans were considered by the US Army Corps of Engineers (USACE) and the General Land Office (GLO) for the Coastal Texas Study during the Alternative Evaluation Analysis stage of the Study Phase between 2016 and 2018, prior to the Study Team settling on the current project for study.⁷³

According to the USACE, “the [Coastal Texas] Study Team identified strengths and weaknesses that allowed them to screen the alternatives based on relative risk reduction performance, construction and life cycle cost, and potential environmental and navigational impacts.”⁷⁴ Since these alternatives were conceptual at the time of the screen, the evaluation was based on estimates for future performance, cost, and impacts.

These alternatives are distinguished between two alignments in Galveston Bay: The Gulf Alignment, which describes Gulf surge across landmasses, and the Interior Alignment, which describes additional defenses along the West Galveston Bay shoreline. The Study Team screened alternatives classified as Gulf Alignments or Interior Alignments and chose a superior option from both alignments for a final alternative for the Coastal Texas Study. Alternative A was chosen as the basis for the Coastal Texas Study.

The Gulf Alignment is a specific component of the Coastal Texas Study and was formulated to reduce the penetration of Gulf surge across the Gulf landmasses and into the Galveston Bay system. All Gulf Alignment Alternatives included the Galveston Island Ring Barrier. **Figure 3** shows the locations of the three alternatives for the Gulf Alignment.

^{xxii} The summary of environmental impacts includes the primary impacts assessed to date. The West Galveston and Bolivar Beach and Dune system, the Galveston Seawall Improvements, and the Nonstructural Improvements either had negligible environmental impacts or were considered beneficial.

Table 4	Coastal Texas Study Gulf Alignment Alternatives Comparison ⁷⁶		
	Alternative A	Alternative B	Alternative C
Storm Surge Mitigation Elements	A levee system across Bolivar Peninsula and West Galveston Island and closure at Bolivar Roads; gates at Clear Lake and Dickinson Bay; and nonstructural measures in West Galveston Bay.	A levee system that bypasses the barrier island and uses existing landscape features such as the Gulf Intracoastal Waterway disposal dikes and the Texas City Dike as the tie-ins for the closure; Clear Lake and Dickinson Bay Gates; and nonstructural measures in West Galveston Bay.	A levee system (longest of the three) starting on the east side of Galveston Bay near Smith Point, continuing across the Bay and the Houston Ship Channel, tying into the existing Texas City Levee System with environmental control gates, small gates for small vessels, and a large gate across the Ship Channel.
Similar Projects	The barrier is similar to projects, such as the Gulf Coast Community Protection and Recovery District's (GCCPRD) Coastal Spine, and Texas A&M University at Galveston's "Ike Dike."	Alternative B has no similar projects.	This barrier is similar to a recommended barrier in a USACE Texas Coast Hurricane Study released in 1979.
Navigation Concerns	Cargo ships would have to travel through the surge-barrier gates, and anchorage areas would be relocated.	Navigation safety concerns exist for the over 300,000 tugs and barges that would pass through the large storm surge barrier. ⁷⁷	Navigation impacts would exist for recreational boaters. Vertical clearances may force some recreational vessels through the large gate near the center of the system that would funnel recreational vessel and Houston Ship Channel vessels through the same route, adding congestion. ⁷⁸
Environmental Concerns	This alternative would impact the natural flow of water into and within Galveston Bay.	This alternative would impact the natural flow into and within Galveston Bay.	This alternative would impact the natural flow of water into and within Galveston Bay. The required location and size of the underwater footprint would have a direct negative impact on Galveston Bay oyster reefs.
Construction Concerns	Environmental gates are needed to maintain natural water circulation in Galveston Bay, with 30 environmental gates needed from the initial estimate.	The Texas City Dike was built to protect Texas City from currents, but not necessarily storm surge. The foundation of the existing structure would need to be improved, and improvements would have major impacts on recreational use on the Dike.	An estimated 100 environmental gates are needed to maintain circulation in Galveston Bay.
Final Evaluation	Alternative A was chosen as the Gulf Alignment for the Coastal Texas Study.	Alternative B was removed from further consideration by the USACE because of the navigation and construction concerns.	Alternative C was removed from further consideration by the USACE because of navigation, construction, and environmental concerns.

The Interior Alignment is a component of the Coastal Texas Study that limits navigation impacts that a coastal barrier presents but provides limited risk reduction to portions of the Gulf shoreline. All Interior Alignment alternatives include developing the Galveston Island Ring Barrier, tying projects into the existing Texas City Levee System and improving that system, and constructing the surge gates and pump stations at Clear Lake and Dickinson Bay.⁷⁹ **Figure 4** shows the locations of the two alternatives for the Interior Alignment.

Figure 4

Coastal Texas Study Interior Alignment Alternatives

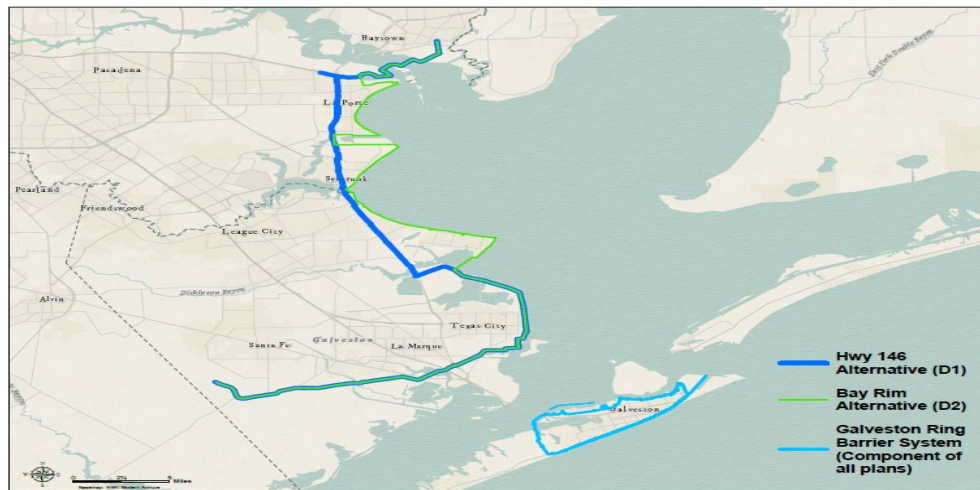


Figure 2.9: Interior Alignments

Source: United States Army Corps of Engineers- Coastal Texas Protection and Restoration Feasibility Study Draft

Alternative D1 was eliminated from consideration by the Study Team as Alternative D2 provided “better performance in terms of reduced risk, with fewer negative impacts.”⁸⁰ **Table 5** provides a summary comparison of key concerns for the Interior Alignment alternatives used during the USACE evaluation process.

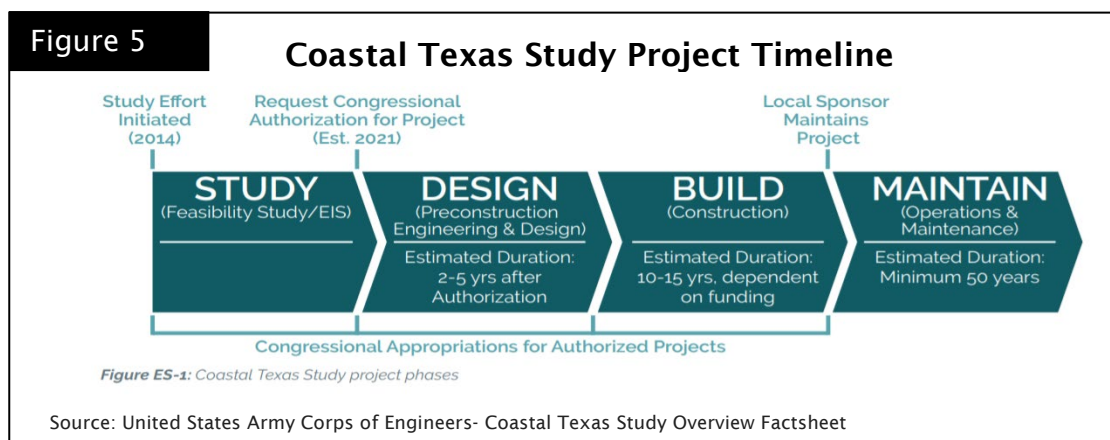
Table 5	Coastal Texas Study Interior Alignment Alternatives Comparison ⁸¹	
	Alternative D1	Alternative D2
Storm Surge Mitigation	A levee system on the west side of Galveston Bay along State Highway 146 from Texas City to the Fred Hartman Bridge. Communities between State Highway 146 and the Bay would require nonstructural projects for protection.	A modified version of the Alternative D1 levee system that would place the levee along the Bay rim instead of State Highway 146 from Texas City to the Fred Hartman Bridge.
Protection Concerns	The levee system does not protect an estimated 10,000 structures that are protected by Alternative D2. An estimated \$175 million in average annual damages would occur in the area covered by D1 without addressing storm surge issues.	The levee system includes the 10,000 structures that were left out of Alternative D1.
Construction Concerns	The area covered is a highly developed area, and existing rights-of-way would be unavailable at the time of construction due to an anticipated expanded highway plan. Additional vehicle and railroad gates would need to be added to the system. ⁸²	Construction concerns in Alternative D1 were addressed with the design modifications for Alternative D2.
Final Evaluation	Alternative D1 did not reduce storm surge risk to critical infrastructures such as medical centers, government facilities, universities, and schools. Alternative D1 was removed from further consideration.	Alternative D2 was chosen as the Interior Alignment for the Tentatively Selected Plan Evaluation.

Coastal Texas Study Alternatives: Final Evaluation. Alternative A and Alternative D2 were chosen October 2018 as the alternatives to consider for the Coastal Texas Study as these alternatives offered two distinct plans to address coastal storm surge risk within Galveston Bay.⁸³ ^{xxiii} Next, the Study Team worked to identify which of the two alternatives would serve as the foundation for the Coastal Texas Study going forward. Additional modeling was used to simulate the performance of each feature to generate a more detailed understanding of costs and benefits. **Table 6** provides a summary comparison of key concerns reviewed by the Study Team during the evaluation, which led to the selection of Alternative A as the basis for the Coastal Texas Study.

^{xxiii} According to the USACE, Alternatives B, C, and D1 were screened out because of impacts that were evident even with less detailed economic information.

Table 6	Coastal Texas Study Tentatively Selected Alternative Evaluation ⁸⁴	
	Alternative A	Alternative D2
Storm Surge Mitigation	A levee system across Bolivar Peninsula and West Galveston Island and closure at Bolivar Roads; gates at Clear Lake and Dickinson Bay; nonstructural measures in West Galveston Bay; and the Galveston Island Ring Barrier.	A levee system along the Bay rim from Texas City to the Fred Hartman Bridge and the Galveston Island Ring Barrier.
Costs	\$14-\$20 billion.	\$18-\$24 billion.
Benefits	USACE Benefit-Cost-Ratio (BCR) for Alternative A and the damage reduction is higher than Alternative D2.	USACE Benefit-Cost-Ratio (BCR) for Alternative D2 and the damage reduction is lower than Alternative A.
Environmental Concerns	<p>The USACE determined Alternative A has a higher indirect environmental risk.</p> <p>Alternative A requires structural supports, and the islands that house the Bolivar Roads sector gates create an obstruction, which may reduce the tidal flow through the Bolivar Roads.</p>	The USACE determined Alternative D2 has a lower localized direct and indirect environmental risk.
Critical Infrastructure	The USACE determined that Alternative A better protects highway and navigation infrastructure than Alternative D2.	The USACE determined that Alternative D2 is worse at protecting highway, emergency service routes, and navigation infrastructure than Alternative A.
Final Evaluation	Alternative A has higher net benefit, greater mitigation of the risk of storm surge, and greater protection for critical infrastructure than Alternative D2.	Alternative D2 has a lower environmental impact than Alternative A. However, the unmitigated risk of flooding in densely populated areas eliminated D2 as a viable alternative by the USACE.

PROJECT PHASES. Figure 5 reflects the project schedule for the Coastal Texas Study, which consists of four phases: Study; Design; Build; and Maintain. The first three phases of the project require a non-federal sponsor to fund a portion of costs and the final phase requires a non-federal sponsor to fund the entire cost.



Study Phase. The Study Phase of the Coastal Texas Study was completed in 2021. This phase included evaluating viable projects for consideration, identifying projects for a feasibility analysis, drafting a feasibility report and environmental impact statement for public feedback, and creating the final feasibility study for review by federal and state agencies. The final USACE Chief of Engineer’s Report will be sent to Congress by summer 2022.⁸⁵ xxiv

Further environmental review will continue through the Design phase of this project. Due to the size of the study area of the Coastal Texas Study and the complexity of the proposed features, USACE will use a multi-phased National Environmental Policy Act (NEPA) or “tiered NEPA” process to assure environmental compliance for the Coastal Texas Study Environmental Impact Statement (EIS).^{xxv} Tier One will summarize the project attributes and environmental impacts at a broad level (including potential effects to human and natural environments for the Coastal Texas Study).

The Tier Two NEPA will describe the exact effects of environmental impacts for individual projects and identify the avoidance, minimization, and compensatory mitigation efforts to lessen the adverse effects of specific projects.⁸⁶ xxvi Tier Two analyses will be conducted over time, which means that supplemental NEPA documentation will be produced as the Tiered features are refined in the Design Phase.⁸⁷

Costs. The Study Phase had an overall estimated cost of \$20.6 million.⁸⁸

Financing. The GLO was responsible for 50% of the study cost, while federal funds, provided through USACE, accounted for the remaining 50%.⁸⁹

^{xxiv} The Final USACE Chief of Engineer’s Report is the summary sent to Congress for authorization based on the Coastal Texas Study’s final recommendations. The USACE Chief signed off on the Coastal Texas Study on September 16th, 2021—making Coastal Texas Study project eligible for federal funding.

^{xxv} The Environmental Impact Statement is the environmental study needed for Coastal Texas Study projects.

^{xxvi} The draft proposal underwent an extended, 75-day public comment period to allow public stakeholders and the local community more time to comment on the draft report. Public comment periods will be held to address public concerns regarding Tier Two project EISs.

Government Stakeholders. For the Study Phase, the USACE, and the GLO, were the key stakeholders involved in the Coastal Texas Study.^{xxvii} The State and Agency review includes elected entities such as the Texas Governor's Office, the US Congress, tribal nations, as well as State and Federal Agencies such as the Texas Parks and Wildlife Department, US Environmental Protection Agency, the US Fish and Wildlife Service, and the National Marine Fisheries Service.⁹⁰ Local government stakeholders, as well as, the general public, also had the opportunity to provide comments during the public comments review of the Coastal Texas Study.

Harris County Involvement. The threats mitigated by the Coastal Texas Study can impact Harris County's residents and businesses, and a small portion of a proposed project, the Clear Lake Gate System and non-structural components between Seabrook and Morgan's Point, are located within Harris County. Coastal Texas Study projects will require regional cooperation.

With the final feasibility study completed, the next steps for the Coastal Texas Study involve seeking authorization through Congress's Water Resources Development Act (WRDA) and appropriation through Congress. Harris County could choose to provide support for the Coastal Texas Study's Congressional authorization and appropriation.^{xxviii}

Harris County could also choose to take an active role in the non-federal sponsor organization, the Gulf Coast Protection District, to help set the course for the GCPD's management of this project (and any future coastal projects).

Design Phase. Between the Study and Design Phases, the USACE Chief of Engineer's Report must be authorized by Congress, as required by the Water Resources Development Act (WRDA).⁹¹ ^{xxix} WRDA is the bi-annual congressional commitment to the nation's water infrastructure projects, which authorizes studies and project construction, and provides guidance for existing USACE projects.⁹² The Coastal Texas Study will require federal authorization through the WRDA or other federal authorization, such as the Infrastructure Investment and Jobs Act, the next opportunity for authorization of the Coastal Texas Study would be in 2022, and followed by appropriation through Congress. For the entirety of the project, federal funding may need to be authorized through multiple WRDA bills.⁹³ The USACE predicts Congressional appropriation for the project could be as early as 2023.⁹⁴ ^{xxx}

^{xxvii} In 2014-2015 USACE conducted a two-year Federally Funded Reconnaissance Study to determine if there was Federal interest in conducting a Feasibility Study for Coastal Storm Risk Management along the Texas Coast. During that time the State of Texas General Land Office (GLO) expressed interest in being the Non-Federal sponsor for the Study Phase and in November 2015 entered into a Feasibility Cost Sharing Agreement (FCSA) with USACE.

^{xxviii} WRDAs are typically one of the last legislative bills to pass, with a final WRDA 2022 bill being signed into law in December 2022.

^{xxix} As reported by the Gulf Coast Protection District, now that the Coastal Texas Study has been signed by the Chief of the U.S. Army Corps of Engineers, projects could be potentially included in the \$1.2 trillion Infrastructure Investment and Jobs Act (also known as the Infrastructure Bill).

^{xxx} The Harris County Engineering Department notes that there is a backlog of authorized projects awaiting appropriations through Congress.

After Congress authorizes the Coastal Texas Study and appropriates the funding for construction, the Design Phase of the project begins. The Design Phase includes preconstruction engineering and design, which provides more detailed designs, cost, and the timeline for each separate project.

In the Design Phase, refinements of the features will be made based on engineering performance, avoidance and minimization of environmental impacts, societal acceptability, and economic justification. The refinements will be constrained by the scope of the project's Congressional authorization (and at the US Army Corps of Engineers' Chief of Engineer's discretion). Activities in the Design Phase (including all public outreach) will adhere to the laws, regulations, and policies governing these projects.⁹⁵

For background on the design, the USACE lead design engineer provided the structures used to model features in the Coastal Texas Study.⁹⁶ The smaller sector gates for the recreation vessels were modeled after the Harvey Canal Sector Gate in New Orleans. The combi-wall used for the Bolivar road crossing, were modeled after the Lake Borgne Surge Barrier in New Orleans. The Shallow Water Environmental Gates were modeled after the Mississippi River Davis Pond Freshwater Diversion structure in New Orleans. The Large Navigation Sector gates with a gate width of 650 feet, were modeled after a combination of the St. Petersburg flood barrier in Russia and the Maeslant barrier in the Netherlands.

Known environmental impacts were disclosed in the project's current Environmental Impact Study, based on the level of detail for the designs known thus far. As designs are refined, the USACE will continue its efforts to avoid and minimize environmental impacts where possible, and develop and implement mitigation to offset unavoidable impacts when determined necessary.⁹⁷ As mentioned in the Study Phase, the supplemental NEPA review will aid with defining any refinements.⁹⁸

Costs. The cost of the Design Phase is built into the total cost of the Build Phase, for a total estimated cost of \$28.9 billion.^{xxx 99 100} Costs are subject to yearly pricing changes.¹⁰¹

Financing. The cost and financing of the Design Phase is incorporated into the Build Phase of the project.¹⁰²

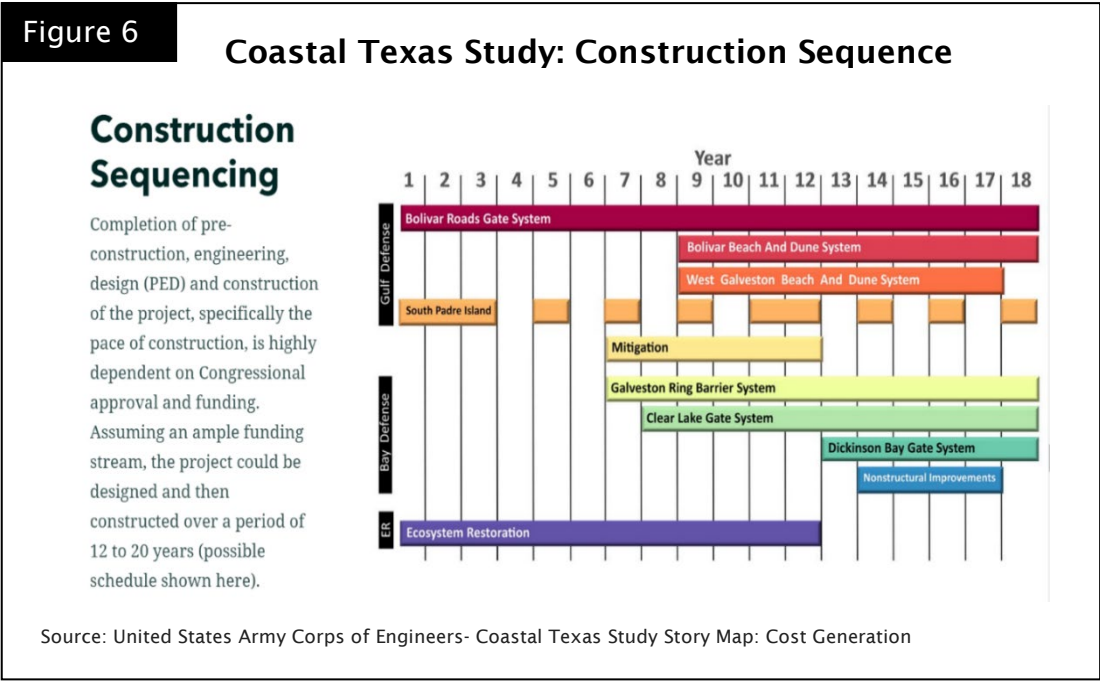
Government Stakeholders. For the transition from Study to Design Phase, local area stakeholders would include support from government stakeholders in the Galveston Bay Area including: Congressional leaders, Texas State senators and State representatives, mayors, county judges, and county commissioners representing the five counties in the Gulf Coast Protection District (Chambers, Galveston, Harris, Jefferson, and Orange counties).

^{xxx} Costs were calculated using Fiscal Year 2021 Price Level with a 2.5% Interest Rate.

The USACE and the members of the Gulf Coast Protection District, the GLO, and/or any other established non-federal sponsor, will be the decision-makers involved in the design of the individual projects within the Coastal Texas Study.

Harris County Involvement. The Coastal Texas Study is 10-65% designed. Specifically, ecosystem restoration is closer to 65% designed, and gate structures across Bolivar, the Ring Barrier, and the Clear Lake and Dickinson Gate Systems are closer to 10% designed.¹⁰³ During the Design Phase of each project, the non-federal sponsor can provide direct feedback to the USACE. Currently, Harris County is a member of the Gulf Coast Protection District, (and as a member, Harris County) can provide feedback on the design, though refinements of the features will be made based on engineering performance, avoidance and minimization of environmental impacts, societal acceptability, and economic justification, and will be constrained by the scope of the project's Congressional authorization (and at the US Army Corps of Engineers' Chief of Engineer's discretion).^{xxxii 104}

Build Phase. While the completion of the project is dependent on a continuous funding stream for construction and no other project interruptions, the US Army Corps of Engineers (USACE) assumes that construction would begin in 2025 and be completed by 2043.¹⁰⁵



^{xxxii} As noted by the USACE, the GBPP will not be included in the Chief's Recommendation to Congress, nor can it be folded into the plan once the Coastal TX project has been authorized. Changes to the Recommended Plan of that magnitude would trigger a General Re-Evaluation Report which would require an additional study (which would require more time and money and would need to be cost-shared). Rather, if the GBPP were to be constructed, the USACE would then consider whether features of the Coastal TX plan would need to be reconfigured or dropped specifically, the Clear Lake and Dickinson Gate Systems, and nonstructural measures for the western side of Galveston Bay. The funds appropriated by Congress for those features could not be redirected to construct the GBPP.

USACE created a Construction Sequence that proposes the pace at which projects can be initiated and completed. **Figure 6** shows that the Bolivar Roads Gate System and Ecosystem Restoration features would be the first projects in the region to start design. Design of the Bolivar Roads Gate system will take five years to complete, and construction would begin immediately thereafter continuing on for the remainder of the Build Phase.¹⁰⁶ **Figure 6** shows that approximately halfway into the Build Phase, the Clear Lake Gate, which is located within Harris County, would commence. The Build Phase is estimated to take 12-19 years to complete.¹⁰⁷

Due to the size of projects, funding uncertainty, and varied timelines for NEPA compliance, the USACE developed multiple prioritization strategies for decision-makers. The USACE will work with GCPD & GLO to finalize the implementation plan subject to Congressional authorization and funding.¹⁰⁸

- **First Line of Defense.**¹⁰⁹ The First Line of Defense strategy would prioritize protecting Galveston Bay from coastal storm surge by constructing the Bolivar Roads Gate first. This approach would also focus on Ecosystem Restoration to slow or stop erosion along the Texas coast. However, many of the communities on the Bay-side of Galveston Island may be left unprotected from in-bay storm surge during a storm without the Galveston Island Ring Barrier System also constructed.
- **Sync Action with Source Material.**¹¹⁰ This strategy prioritizes developing and maximizing construction cost savings primarily through efficiencies, including using dredged materials from adjacent navigation projects in Coastal Texas projects.^{xxxiii}
- **NEPA Driven.**¹¹¹ The NEPA Driven strategy would prioritize environmental compliance and allow the construction of individual projects as soon as environmental compliance is achieved.
- **Equitable Regional Distribution.**¹¹² This strategy would focus on building components in each region along the coast for a broader distribution of benefits and protection.
- **“No Regrets.”**¹¹³ This strategy would be based on a risk evaluation considering funding uncertainties and the possibility that the entire plan may not be constructed. Projects that could stand alone, separate from any other portion of the recommended plan would be prioritized.

Costs. Based on the final feasibility report, the Design and Build Phases of the draft proposal are estimated to cost a cumulative \$28.9 billion, including \$19.9 billion (69%) for Gulf Defense Projects, \$6.3 billion (22%) for Bay Defense Projects, and \$2.7 billion (9%) Ecosystem Restoration.¹¹⁴ ^{xxxiv} The USACE cost estimate includes estimates for required equipment, labor, and material costs.¹¹⁵ ^{xxxv} ^{xxxvi}

^{xxxiii} The Houston Ship Channel Expansion Project 11 is provided as an example.

^{xxxiv} For context, when adjusting the cost of storms making landfall in the region, the recovery costs for Hurricane Rita was calculated at \$24.3 billion and for Hurricane Ike, \$35.7 billion.

^{xxxv} After the release of the draft Report in 2020, the USACE undertook a detailed cost estimate review, including a cost and schedule risk assessment. The revised cost estimate added contingency costs into the estimate for potential gate-operation inducements, dewatering of the channel for the construction of the artificial islands, and increased costs for steel quantities due to the rising costs evidenced in the current market pricing.

^{xxxvi} The federal share of the combined project is \$17.98 billion, and the non-federal share is \$10.89 billion.

Table 7 reflects the \$19.9 billion total cost of Gulf Defense Projects (including \$16 billion for the Bolivar Roads Gate System; \$3.8 billion for the Bolivar and Galveston Beach and Dune System).¹¹⁶ With \$6.3 billion as the total cost of In-Bay Projects (including \$3.5 billion for the Galveston Ring Barrier System; \$1.6 billion for the Clear Lake Gate System; \$898 million for the Dickinson Bay Gate Systems; and \$390 million for nonstructural measures in West Galveston Bay).¹¹⁷ Additionally, \$2.7 billion is the total cost of Ecosystem Restoration Projects for the Coastal Texas Study (including \$935 million for the “G28” Bolivar Peninsula and West Bay Shoreline Protection Project within Galveston Bay).¹¹⁸

Table 7	Coastal Texas Study Costs
Study Phase ¹¹⁹	\$20.6 million
Build Phase	Gulf Defense Projects \$19.9 billion (69%) Bay Defense Projects \$6.3 billion (22%) Ecosystem Restoration \$2.7 billion (9%) Total Cost: \$28.9 billion ^{xxxvii}
Maintain Phase	\$131 million annually

Financing. The funding responsibility for construction costs is split between the federal sponsor, the US Army Corps of Engineers (USACE), financing 65% of costs, and the non-federal sponsor, which is required to provide 35%. The cost of ongoing beach and dune renourishment is split between the federal sponsor (50%) and non-federal sponsor (50%).¹²⁰

For the federal funds, appropriations from Congress will likely be an incremental process of getting funding for projects at different points of the Construction Sequence. The total construction cost is not expected to be provided all at once.¹²¹

The Gulf Coast Protection District (GCPD), created in the 87th Texas State Legislature, will issue bonds, impose fees, and/or impose a tax to account for the non-federal sponsor’s contributions.”¹²² Any taxes or bonds to finance the Coastal Texas Study projects would need to be voted on by a majority of voters in the five-county districts.¹²³ The GCPD would not require a voter approval to impose fees.

According to GCPD members, the GCPD has taxing authority similar to a Special District or Water District, with all five counties within the district as one taxing jurisdiction.¹²⁴ If taxes or bonds are needed to finance the project, the GCPD will hold a district-wide election, but each individual

^{xxxvii} Costs were calculated using Fiscal Year 2021 Price Level with a 2.5% Interest Rate to calculate the total cost using 2043 as the base year of completing the Galveston Bay Storm Surge Barrer System.

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county will reportedly be responsible for administering the election.¹²⁵ Any new tax will be approved if a majority of all residents in the district vote to approve it. Any tax is capped at five cents per \$100 assessed value.¹²⁶

Alternative funding mechanisms to a tax are actively being reviewed by the Board.¹²⁷

According to an interview with the Economic Alliance Houston - Port Region, a report currently being reviewed by the GCPD identifies resilience bonds as a potential funding mechanism for the non-federal sponsor for the Coastal Texas Study. A resilience bond is a bond mechanism “developed to (1) expand financial protections—in the form of catastrophe insurance coverage, and (2) leverage new project finance for resilient infrastructure projects that measurably reduce risk.”^{128 xxxviii}

Government Stakeholders. USACE and the members of the GCPD along with the GLO, or any other established non-federal sponsor, will be the decision-makers involved in the construction of the individual projects within the Coastal Texas Study.^{xxxix}

Harris County Involvement. Harris County is currently a member of the five-county Gulf Coast Protection District, and in this capacity, could contribute to the management of the build and the administration of funds for the construction of projects.

Maintain Phase. The designated non-federal sponsors will be responsible for operations and maintenance once construction of the features is complete.¹²⁹ At the conclusion of the Build Phase, the non-federal sponsors of the project would pay for maintenance and operations in perpetuity.¹³⁰

Costs. The current cost estimate for ongoing operation and maintenance of the Coastal Texas Study is \$131 million annually.^{131 xl}

Financing. The non-federal sponsor is entirely responsible for ongoing operation and maintenance of the constructed projects.

Government Stakeholders. The non-federal sponsor will be the decision-maker involved in the maintenance and operation of the individual projects within the Coastal Texas Study.

Harris County Involvement. Harris County is currently a member of the five-county Gulf Coast Protection District, and in this capacity, will

^{xxxviii} Members of the Gulf Coast Protection District have explained that an Innovative and Alternative Financing Committee is reviewing alternative funding sources, including reviewing whether social impact bonds could aid with funding these projects. Social impact bonds are a contract with the public sector or governing authority, whereby that entity pays for better social outcomes in certain areas. The report on social impact bonds will be made public after GCPD review, but was not available at the time of publication of this memo.

^{xxxix} GLO is the non-federal sponsor responsible for ecosystem restoration projects along the entirety of the Texas Coast, and the South Padre Island Beach Nourishment and Sediment Management project.

^{xl} The total estimated annual maintenance cost for the Recommended Plan is \$131,000,000 based on the current federal FY2021 discount rate of 2.5%.

contribute to the administration of funds for the operation and maintenance of the Coastal Texas Study.

THE GALVESTON BAY PARK PLAN

The Severe Storm Prediction, Education and Evacuation from Disaster (SSPEED) Center at Rice University serves as a research center dedicated to developing protection strategies against hurricane-related surge and other threats associated with severe storms and hurricanes in the Gulf Coast region.¹³²

The SSPEED Center designed a surge protection system, the Galveston Bay Park Plan (GBPP), which proposes utilizing local dredge material from the widening of the Houston Ship Channel.^{xli} These materials would create an in-bay storm surge barrier built to 25 feet of elevation above sea level, extending from Baytown to Texas City, running along the eastern side of the Houston Ship Channel, and raising the Texas City Levee.¹³³ To maintain access to the Port of Houston, this proposal includes a mid-bay navigation gate for recreation and commercial ships.¹³⁴

The Galveston Bay Park Plan proposes a multi-functional barrier system, which would also operate as a recreational park within Galveston Bay.¹³⁵ To maintain access to the new isolated bay on the west side of Galveston Bay, the plan includes at least five smaller access gates for small crafts passing through the inner bay barrier.¹³⁶ With the construction of the park, the SSPEED Center estimates 10,000 acres of public lands for recreation, miles of new shoreline, and more access to the bay's ecosystem would be added to Galveston Bay.¹³⁷

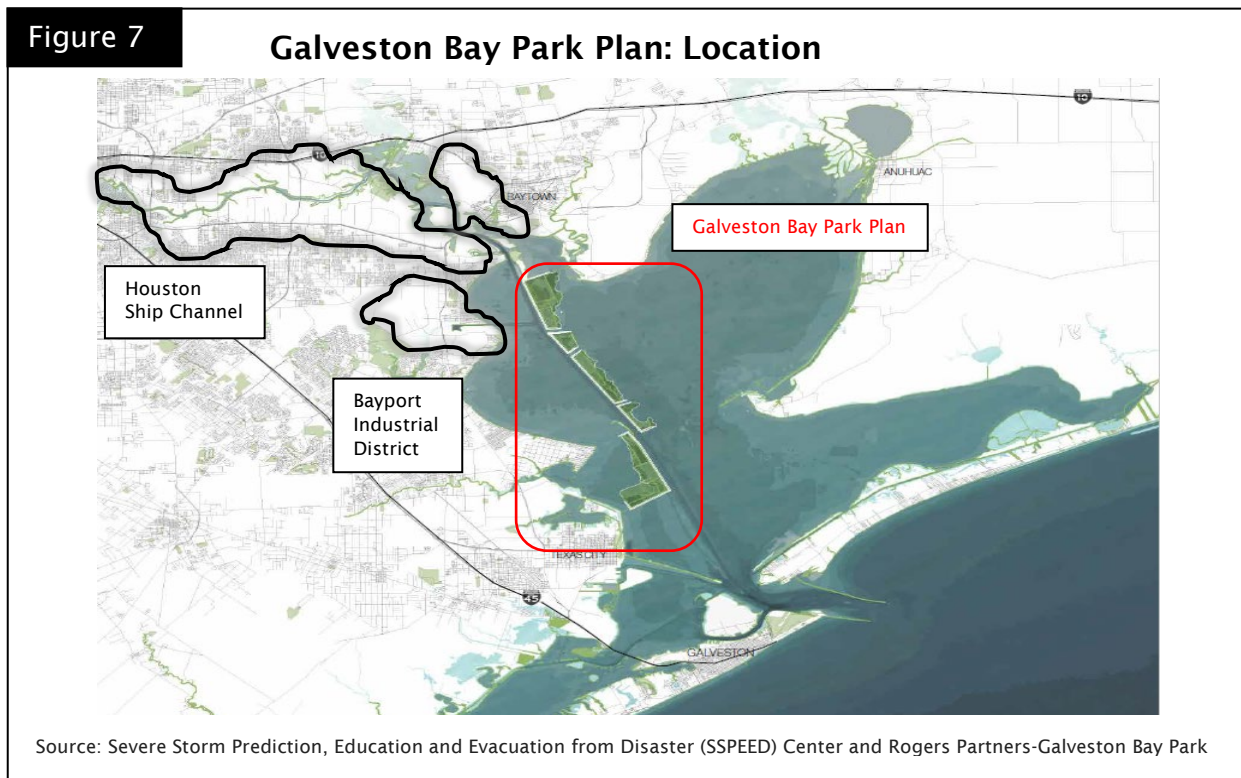
The SSPEED Center estimates that without significant sea level rise and a coastal barrier preventing Gulf water from entering the Bay, Galveston Bay has sufficient water to generate a storm surge event of 20 feet from strong hurricane-force winds.¹³⁸ The SSPEED Center analysis notes that if constructed in tandem with the Coastal Texas Study, there will be a large reduction in storm surge flooding through the entire Bay.¹³⁹ According to Jim Blackburn at the SSPEED Center, the GBPP is designed to protect West Galveston Bay shoreline from anticipated storm surge coming over the Bolivar Roads Gate.¹⁴⁰ The GBPP would divert storm surge water into the Trinity Delta.¹⁴¹

The US Army Corps of Engineers and Texas General Land Office confirmed that the GBPP and the Coastal Texas Study are compatible projects and concluded that the two projects can be designed to be complementary and are not in competition with each other.¹⁴² Colonel Timothy Vail, Commander of the USACE Galveston District, noted that "the construction of [the Galveston Bay Park Plan] does not preempt the construction of the other."¹⁴³ USACE and GLO note that the GBPP could be an alternate solution to elements of the Coastal Texas Study, specifically aspects of the In-Bay Projects (Clear Lake Gate, Dickinson Bayou Gate, and the non-structural components along the west side of the bay).¹⁴⁴

The SSPEED Center is not seeking federal funding for their project and will not require non-federal sponsorship, like the Coastal Texas Study.¹⁴⁵

^{xli} Under the Galveston Bay Park Plan, includes widening the Houston Ship Channel by 200 feet from 700 feet to 900 feet across.

Figure 7 reflects the location of the Galveston Bay Park Plan.



PROJECT PHASES. As of publication of this memo, there is no official timeline for the development or construction of the Galveston Bay Park Plan, and there are no completed engineering designs nor environmental analyses for the Galveston Bay Park Plan.¹⁴⁶ The Analyst's Office will use the same four project phases that the USACE uses for the Coastal Texas Study to describe the elements of the Galveston Bay Park Plan. The four categories include: Study, Design, Build, and Maintain.

While the threats mitigated by the Galveston Bay Park Plan can impact Harris County's residents and businesses, no part of the construction of the Galveston Bay Park Plan takes place within Harris County.

Study Phase. The SSPEED Center is currently soliciting funds for a feasibility study to determine feasibility for construction. The feasibility study will:

- Develop the engineering design for the plan;
- Model GBPP protections with and without the gates at Bolivar Roads; the hydrology effects such as rainfall-runoff and surge under flooding events in the Bay; and, water circulation in Galveston Bay with and without GBPP;¹⁴⁷
- Develop a proposed framework for the US Army Corps of Engineers permit application process for the Galveston Bay Park Plan;^{xlii}

^{xlii} The feasibility study is researching aspects of the USACE permitting process. No decision has been made to apply for a permit with that decision being made after the feasibility study is completed and the GBPP can be constructed for a reasonable price.

- Analyze access to dredge materials, including estimating anticipated costs, developing engineering designs, and developing next steps with the Port of Houston and USACE;¹⁴⁸
- Complete an initial environmental study with the goal to identify the information needed to develop the National Environmental Policy Act (NEPA) analysis;^{xliii 149}
- Verify and validate current cost estimates for construction of the project; and,
- Propose financing options.^{150 xliv}

Cost.^{xlv} The SSPEED Center feasibility study is estimated by the SSPEED Center to cost \$1,000,000.¹⁵¹ The Port of Houston has reportedly committed \$250,000 to the cost of the feasibility study, and the SSPEED Center is in negotiations with the City of Houston, Harris County Flood Control District, and a private citizen for additional contributions of \$250,000 each.¹⁵² While both the City and the County Flood Control District have reviewed the scope, no commitments have been made for this funding, the decision to sign the contract and fund the project will come back to court at a later date.^{153 154}

Financing. The SSPEED Center does not currently plan to apply for federal funding or grants for the GBPP. The SSPEED Center reports the GBPP will be financed with local sources as not to compete with the Coastal Texas Study.¹⁵⁵

Government Stakeholders. The study of this Plan will require collaboration with the USACE, the Texas General Land Office, and local governmental entities and representatives from jurisdictions around Galveston Bay (including Chambers, Brazoria, Galveston, Harris counties).¹⁵⁶ It is unclear how this engagement will be pursued by proponents.

Harris County Involvement. The threats mitigated by the GBPP can impact Harris County's residents and businesses. Harris County Flood Control District could provide the match with the City of Houston and a private citizen to fund the feasibility study. Other opportunities for involvement are currently undefined as coordination by proponents is unclear.

Design Phase. According to the SSPEED Center, the feasibility study will provide an engineering design to better understand the cost and to fulfill the engineering requirements for the permitting process. The USACE permit application process is estimated to take 18 months to complete once the feasibility study is completed.¹⁵⁷ The Galveston Bay Park Plan will conduct an environmental evaluation and additional modeling to determine the requirements for environmental clearances.¹⁵⁸ This preliminary environmental report will be the basis for required National Environmental Policy Act (NEPA) studies for the construction of the plan.¹⁵⁹

^{xliii} The NEPA study would be initiated when the USACE permit application is filed.

^{xliv} The GLO indicated at the GBPP would need a lease from the GLO for the project since the project is on state-owned submerged lands.

^{xlv} The Harris County Flood Control District estimates that an additional \$10 million would be needed to develop the required planning documents to move forward with the Galveston Bay Park Plan. These planning documents including, environmental studies and permitting, public engagement and outreach, and engineering plans.

Cost. The cost to design the Galveston Bay Park Plan will be covered during the feasibility study as proponents for the Plan intend for design to be complete during the feasibility study.

Financing. The SSPEED Center does not currently plan to apply for federal funding or grants for the GBPP. The SSPEED Center reports the GBPP will be financed with local sources as not to compete with the Coastal Texas Study.¹⁶⁰

Government Stakeholders. The design of this plan will require collaboration with the USACE, the Texas General Land Office, and local governmental entities and representatives from jurisdictions around Galveston Bay (including Chambers, Brazoria, Galveston, Harris counties).¹⁶¹ It is unclear how this engagement will be pursued by proponents.

Harris County Involvement. As the design of the Plan is scheduled to be completed during the study of the Plan, Harris County Flood Control District's involvement remains providing the match with the City of Houston to fund the feasibility study.

Build Phase.^{xlvi} The Build Phase includes the construction of the 25-foot high barrier island. Proponents of the Plan currently plan to use dredged material from the Houston Ship Channel to create the barrier islands. Understanding the timing of future Port of Houston's plan to widen the Houston Ship Channel is critical in determining the potential timing of the Galveston Bay Park Plan.

To date, the Port of Houston has not begun the formal process of planning the next major Houston Ship Channel improvement project, which will likely include widening and deepening initiatives, and generate a significant amount of dredged material, which may be useful to both the Coastal Texas Study and Galveston Bay Park Plan projects. The Port of Houston will be seeking federal funding for the improvement project. The Port provided a preliminary timeline for this, considering the current federal and USACE processes. The Port estimates the earliest any dredged materials from construction would available is 2031 or later.¹⁶²

The SSPEED Center is taking the timeline into consideration by incorporating the cost of widening the Ship Channel into the cost of the Galveston Bay Park Plan to potentially start the widening of the Houston Ship Channel sooner than the projected federal timeline.¹⁶³

Cost. Build costs are currently estimated to be between \$3 billion to \$5 billion for construction.¹⁶⁴ Once the SSPEED Center funds and completes the feasibility study, the detailed construction cost estimate will be updated and verified.

Financing. The SSPEED Center does not currently plan to apply for federal funding or grants for the GBPP. The SSPEED Center reports the GBPP will be financed with local sources as not to compete with the Coastal Texas Study.¹⁶⁵

^{xlvi} It is unknown at this time how the project will be advertised for bid, how the project will be awarded, and who will oversee construction.

The SSPEED Center anticipates that the financing options will include outcomes-based financing, such as resilience or social impact bonds, to provide capital needed for construction. Resilience and social impact bonds are contingent on specific and verifiable results such as reduced flooding, mitigation of storm surge impact, and improvement of other environmental, economic, and social outcomes.^{166 167} An economic advisory group (consisting of Rice University economists, ecological economists, an outcome-based capital firm, and insurance companies) will review various financing options for the GBPP.¹⁶⁸

Government Stakeholders. The design of this plan will require collaboration with the USACE, the Texas General Land Office, and local governmental entities and representatives from jurisdictions around Galveston Bay (including Chambers, Brazoria, Galveston, Harris counties).¹⁶⁹ It is unclear how this engagement will be pursued by proponents.

Harris County Involvement. Harris County's involvement at this stage is unknown at this juncture.

Maintain Phase. Proponents of the Plan advise maintenance costs of park and gate operations and ongoing financing will be researched within the feasibility study.¹⁷⁰

Cost. Maintenance costs, which includes maintenance and operating costs, are not available and will be evaluated in the feasibility study.

Financing. Financing of ongoing costs will be researched during the feasibility study.

Government Stakeholders. The design of this plan will require collaboration with the USACE, the Texas General Land Office, and local governmental entities and representatives from jurisdictions around Galveston Bay (including Chambers, Brazoria, Galveston, Harris counties).¹⁷¹ It is unclear how this engagement will be pursued by proponents.

Harris County Involvement. Harris County's involvement at this stage is unknown at this juncture.

STORM SURGE RISK MITIGATION

The degree to which storm surge may be mitigated depends on the many characteristics of the associated storm, including magnitude and path. Two storms serve as the standard for modeling the mitigation of risk to the area around Galveston Bay: Hurricane Ike (2008) and Tropical Storm Imelda (2019).

Hurricane Ike made landfall just southeast of Galveston County in 2008 and generated a tremendous storm surge event for a Category 2 hurricane.¹⁷² Hurricane return rates predict a Category 2 hurricane will make landfall every nine years, with a hurricane capable of creating a storm surge event similar to Hurricane Ike making landfall every 100 years.¹⁷³ The storm surge recorded in Harris County during Hurricane Ike was 13 feet.

According to the Environmental Protection Agency (EPA) estimates for future sea level rise in the Gulf Coast, the recorded 13-foot heights at Shoreacres and Seabrook during Hurricane Ike would equate to a 14-foot storm surge in 2050, and 15-foot-to-17-foot storm surge in 2100.^{xlvi} ¹⁷⁴

Tropical Storm Imelda made landfall in Brazoria County in 2019 and generated a maximum storm surge height of 2.3 feet in Eagle Point and Morgan's Point in Galveston Bay.¹⁷⁵ Assuming the same EPA estimates for sea level rise in the Gulf Coast, a 2.3-foot storm surge in 2019 would equate to a 3.3-foot storm surge in 2050 and a 4.3-to-5.3-foot storm surge in 2100.^{xlvi}

This section provides a brief description of storm surge risk mitigation for the Coastal Texas Study and the Galveston Bay Park Plan.

COASTAL TEXAS STUDY.^{xlvi} While any storm surge mitigation system will not provide complete risk reduction to the Texas Coast from every storm, models demonstrating the risk mitigation of the current Coastal Texas Study projects show a potential 10-foot reduction in storm surge during a Category 2 hurricane.¹⁷⁶ ¹ The City of Galveston will see reductions in storm surge due to the Galveston Island Ring, but flooding is a possibility under extreme events.¹⁷⁷

The amount of storm surge mitigation will vary depending on the orientation of the storm, landfall location, and storm intensity, but once fully constructed, the USACE estimates the Coastal Texas Study will reduce annual damages to the entire Texas Gulf Coast region by \$2.3 billion and create or restore thousands of acres of coastal habitat.¹⁷⁸ ⁱⁱ The project will reportedly provide a 77% reduction of damage structures and a 64% reduction in flooded critical infrastructure points.¹⁷⁹

The models below show different storm surge scenarios with Coastal Texas Study projects and without projects in and around Galveston Bay, beyond the Category 2 hurricane scenario described above. These models are using projects in the current iteration of the Coastal Texas Study.

Figure 8 models a storm surge event projected to occur once every 50 years, with a maximum storm surge of nine feet, similar to Tropical Storm Imelda, and includes a sea level rise of 2.2 feet over current sea level. Barriers will not likely be closed in this situation.¹⁸⁰ As demonstrated, there is less coastal flooding with the Coastal Texas Study projects.

^{xlvi} The Analyst's Office calculated these figures by adding the predicted sea level rise to the storm surge experienced in Harris County during Hurricane Ike.

^{xlvi} The Analyst's Office calculated these figures by adding the predicted sea level rise to the storm surge experienced in Harris County during Tropical Storm Imelda.

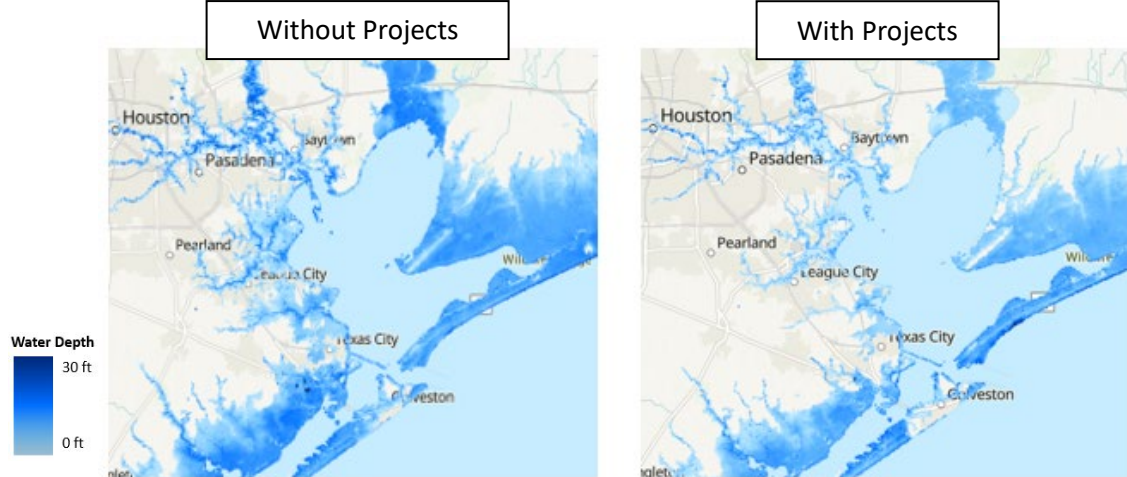
^{xlvi} According to the US Army Corps of Engineers (USACE), the storms that were selected for modeling were the most destructive scenarios for storm surge and wave conditions.

¹ Storm #342

ⁱⁱ Based on a discount rate of 2.5%.

Figure 8

Coastal Texas Study: Modeled for a 50-year Storm

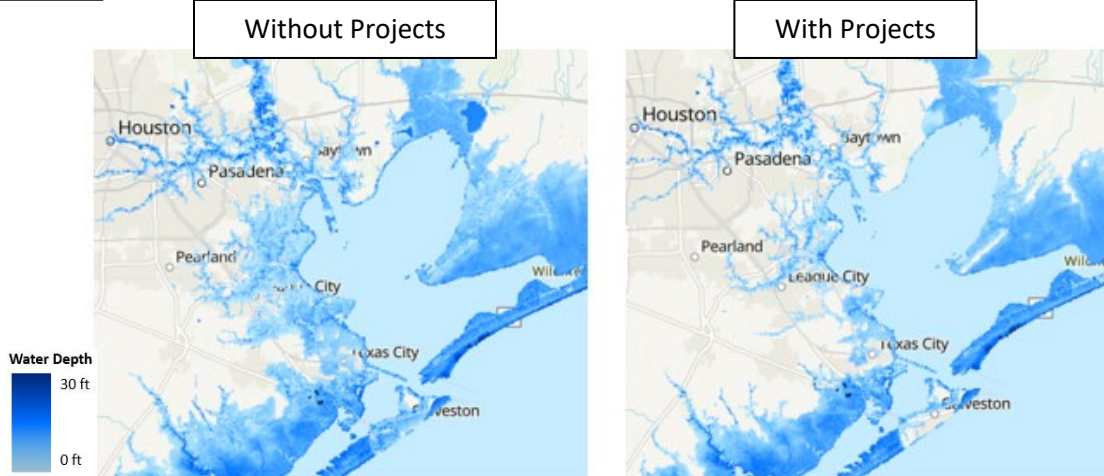


Source: US Army Corps of Engineers (USACE) 50 Year Inundation

Figure 9 models a storm surge event projected to occur once every 100 years, with a maximum storm surge of 18 feet, similar to Hurricane Ike, and includes a sea level rise of 2.2 feet over current sea level. Barriers will likely be closed in this situation.¹⁸¹ As demonstrated, there is less coastal flooding with the Coastal Texas Study projects.

Figure 9

Coastal Texas Study: Modeled for a 100-year Storm

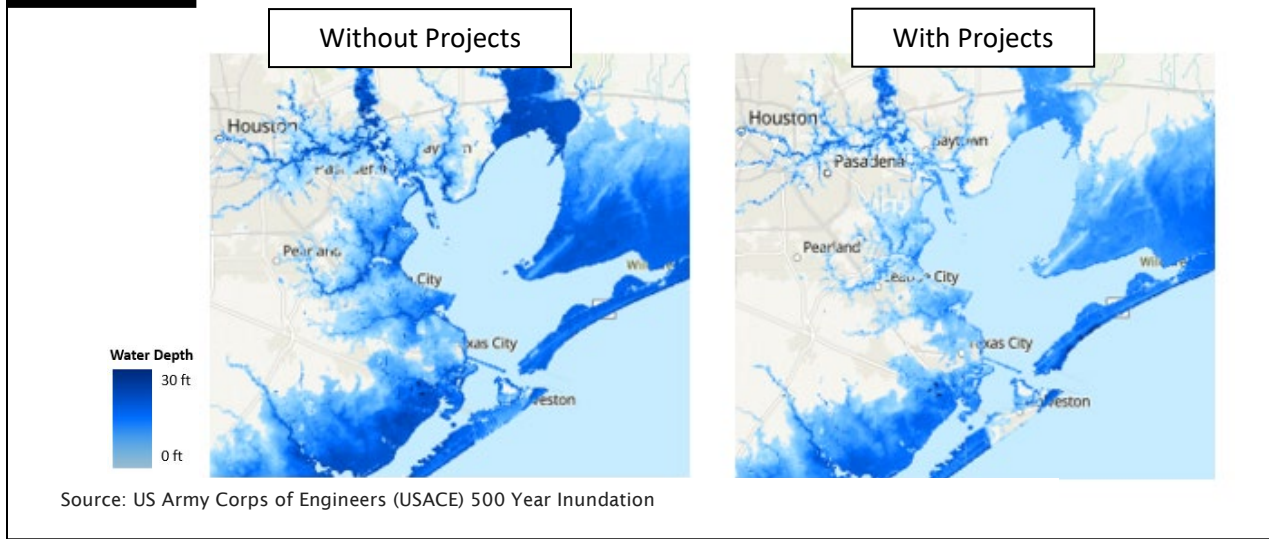


Source: US Army Corps of Engineers (USACE) 100 Year Inundation

Figure 10 models a storm surge event projected to occur once every 500 years with a maximum storm surge of 24 feet, more powerful than Hurricane Ike, and includes a sea level rise of 2.2 feet over current sea level. Barriers will likely be closed in this situation.¹⁸² As demonstrated, there is less coastal flooding with the Coastal Texas Study projects.

Figure 10

Coastal Texas Study: Modeled for a 500-year Storm

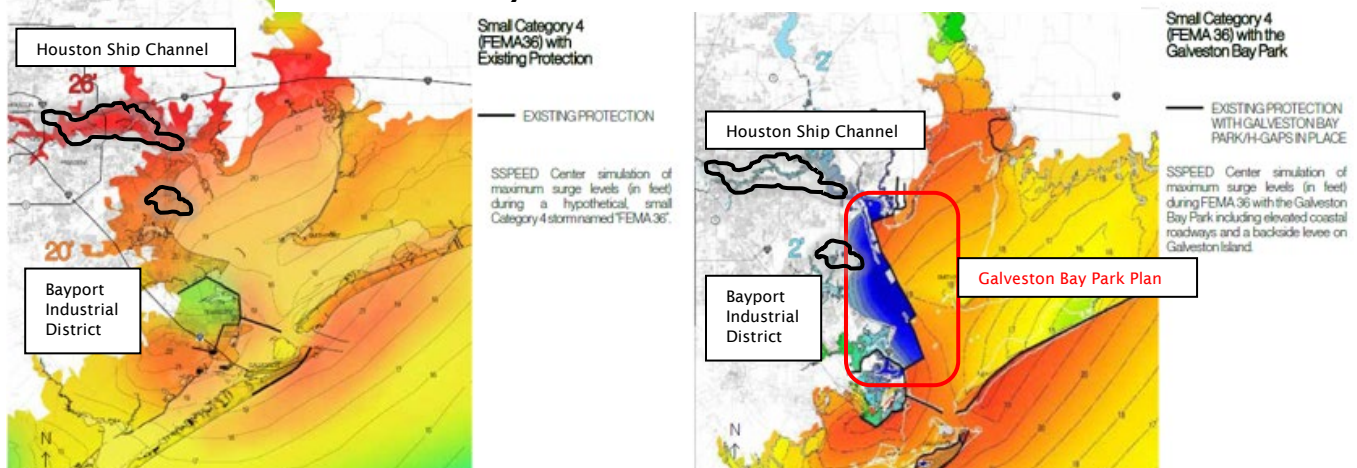


GALVESTON BAY PARK PLAN. The SSPEED Center designed the Galveston Bay Park Plan (GBPP) to protect the western shore of the Bay against a 25-foot storm surge that could be generated by a large Category 4 hurricane.¹⁸³ A Category 4 hurricane capable of producing a 25-foot storm surge in Galveston Bay is projected by the SSPEED Center to occur every 250 years.¹⁸⁴ Additional studies are required to confirm the expected mitigation of risk.

Figure 11 models the level of protection the SSPEED Center for a Category 4 hurricane in Galveston Bay with existing protections and with the Galveston Bay Park Plan. This model does not include projections with any Coastal Texas Study projects, though the SSPEED Center intends for the GBPP to exist alongside the Coastal Texas Study.

Figure 11

Galveston Bay Park Plan: Modeled Protection



Source: Severe Storm Prediction, Education and Evacuation from Disaster (SSPEED) Center and Rogers Partners-Galveston Bay Park Plan

CONCLUSION

The two projects reviewed, The Coastal Texas Study and Galveston Bay Park Plan, are both designed to mitigate the risk of coastal flooding caused by storm surge. Harris County may choose to support one or both projects—both projects can coexist and are not in competition. Neither project is designed to protect the region from inland flooding caused by slow-moving, wet cyclones—like Hurricane Harvey.

Within the Gulf Coast Protection District (GCPD), Harris County is not responsible for directly funding the Coastal Texas Study, however, the County has an opportunity to join regional partners in directing the future of the projects in the Study. Harris County participation through the GCPD may include exploring and advocating for funding mechanisms with the GCPD Innovative and Alternative Financing Committee and aiding with seeking Congressional authorization appropriations during the lifecycle of project builds. Additionally, Harris County could work with Congressional delegates to understand possible funding mechanisms in the Infrastructure Investment and Jobs Act.

Simultaneously, the Harris County Flood Control District may choose to continue negotiations with partners at Rice University's Severe Storm Prediction, Education and Evacuation from Disasters Center (SSPEED Center) in seeking funding for the initial feasibility study required for the Galveston Bay Park Plan as well as support the introduction of that plan to other key regional partners, whom may not have been engaged on this to date.

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The Harris County Commissioners Court's Analyst's Office provides the Harris County Commissioners Court members with objective, nonpartisan, and timely fiscal and policy analysis related to the efficiency and effectiveness of various County operations.

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